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"LUNA 21": HOW THE LANDING STAGE WAS  
DEVELOPED BEHIND THE THRESHOLD OF THE  
DESIGN BUREAU

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Wright-Patterson Air Force Base, Ohio

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22

"LUNA-21": HOW THE LANDING STAGE WAS DEVELOPED  
BEHIND THE THRESHOLD OF THE DESIGN BUREAU

M. Borisov, Engineer

Seventh Heaven

If on the seventh floor one were to leave the elevator and go along the corridor to the right, along the way he would encounter a folding door. On it there is a placard: "Please do not disturb before 12 o'clock." This is the realm of the designers, their seventh heaven.

Beginning at the door is a "large path," along which a stream of designers spreads out along narrow paths to their own desks, to the drafting boards, to complex and very difficult tasks.

Long ago did not bitter arguments boil up here about the composite drafts of automatic stations, which only at the moment of launching acquired a name which was fully specific and caused no problem? This was the name of the final point of its difficult journey - "Luna." and now this "long ago" is already history.

On one of the far-off days on one of the walls of the hall freshly printed television panoramas spread out in a line. These involuntarily became an "experimental" test. "Luna-9" and "Luna-13," from a height of no more than a meter above the lunar surface,

reported interesting data about the surface of the moon. And guess what? There was no layer of dust many meters in depth. The stations transmitted clear television panoramas, telemetric information.... The devil take it, they worked! Caves, subsurface cavities, at least in the areas where the stations landed, were absent. This means that it is possible to settle on the moon and not sink in, to not be "buried"....

But the main point is something else - this means that it is possible to begin the designing of heavy lunar stations, and they in turn will make it possible not only to apply new methods of investigation, but also to considerably extend the regions in which the investigations will be conducted.

Thus almost by the beginning of the seventies automatic lunar stations appeared which were later named luniks of the 2nd generation, which differed mainly by the considerable weight of the equipment which could be delivered to the moon, and by the presence of a landing stage. And just what is a landing stage?

I was a witness when one comrade jokingly asked this question of Nikolay Ivanov, the designer who in his time produced a composite layout for this station. In the eyes of Ivanov I did not see the usual softness. On the contrary, in them there was a challenge. "How is this," he says, "you who have worked in the design bureau so many years still do not know what a landing stage is. It is a shame." For him the landing stage embodied the entire station and those devices which it placed on the moon, as if they were affixed to it.

And if this same question was asked by the "compiler" of the lunakhod, then he would answer approximately as follows:

- A landing stage - this is the platform which only placed on the moon the newest, most complex, and cleverest remote-controlled

research equipment, which....

But all joking aside. A landing stage, as is evident from the name, is intended for landing on the moon. However, this is not an end in itself. In one case it can place a lunakhod there, in another - a "Moon-Earth" space rocket with returnable equipment. In this lies its unification.

Space flight of an automatic lunar vehicle of the second generation consists of several phases of flight to another heavenly body. It has already become reading-book: flight after launching from the orbit of an artificial earth satellite, movement in orbit around the moon, the making of a correction in this orbit, and, finally, the realization of a soft landing on the moon.

All of these phases, with the exception of launch, are done with the help of the landing stage. And if one were to add to this that for launching a "Moon-Earth" rocket from the moon the landing stage is also the launching device, and lowering gangways are mounted on it for the lunakhod, then the sternness with which Ivanov met this "puzzling" question can be understood, and even justified.

The landing stage owes its appearance to the age-long practicality of man - to have only that which one cannot do without. In space flight practicality becomes an axion, an unalterable law, the breaking of which can lead to nonfulfillment of the main, overall mission of the flight.

Initial Draft

But ahead of the remaining designers "came" Nikolayev, the head of the brigade. Having the personal commission of the Head Designer, he, with the help of administrators, radio operators, electricians, and their assistants, attempted to picture the stage-by-stage solution of the problem.

- This means - he explained to the workers of his brigade.

- We are given a type of carrier which should....

On parchment a strange design was drawn - the initial estimate of a landing stage. Ahead was the usual, laborious, humdrum search for the optimum solution, which would be acceptable for all interested personnel and organizations.

The diversity, contradictory nature, and complexity of the requirements for a landing stage created a specific microclimate, which by no means fostered a "smooth flow" of design developments. Therefore the path of parallel designing was accepted as the most rapid and reasonable. It amounted to the fact that several operational groups, made up of "thinking designers," were given the initial data for the designing of the landing stage.

Variants were needed.

Incidentally, the method of parallel designing is, in my opinion, in general also the most objective, since the result of the effort is the fruit of the labor of the collective, and not of the individual.

Included in the "initial data" were requirements, the expediency and reliability of which were naturally lacking in any ponderable confirmations. In fact nobody had been to those places where the stations would have to set down. Based on the assigned requirements man, who understood the topography in the least sense, could if desired reconstruct the relief of the landing areas: alluvial deposits of lunar rocks of different calibres, fissures running in different directions. Even the area itself in principle could

be found (and to scientists at least everything is interesting) not only in the plains of the sea areas, but also on spurs of ranges of gloomy lunar mountains, or on the slopes of craters.

One of the main points of the requirements was the number of kilograms assigned to the landing stage. For the designer this weight became his unique Rubicon, the crossing of which was categorically forbidden. Here the landing stage in no case should break up, fail, settle back, bounce like a ball, having arrived at such a "terrible" area.

The proposals of the designers were usually examined at separate forums, in which the workers from other brigades took part. And even the faultfinding bookkeepers would envy the scrupulousness of the designers, the manner in which they calculated everything which was brought into the general discussion which was "for" and "against" the composite arrangements for a station.

And each of them had their own qualities and shortcomings. Take the variant of a "two-story boublik" [ring-shaped roll], or, strictly speaking, a toroidal system. The shock absorber - the lower boublik - was easy, 1:0 in favor of the toroidal system. Then the fuel tank in the form of a "hose" rolled into a ring turned out to be considerably heavier than four fuel tanks of spherical form. The count became 1:1. And if it is considered that a system which forces the fuel into the power plant from the "boublik" is more complex than that from a "sphere," then the count increases to 1:2, as they say, not in our favor.

And here is the choice. For a whole number of reasons, and there was a great multitude of them and the count was already made in "two-place figures," the forum stopped on spherical tanks.



Many questions were cleared up and the designers gradually switched to the carrying out of other urgent matters. The results of the studies, true, without any credentials and not in anniversary cases, as they were readied were transmitted to Ivanov, who would bring the stage to condition - would produce a composite drawing of it. But still the "universities" attended by comrades helped him very much.

The road on which he traveled was restricted on both sides by special signs: "not reliable," "not suitable," "unproven," "with difficulty." His comrades pointed them out. But there were also sections without limiting signs. They also led to a sad conclusion: a landing made with spherical fuel tanks was unequivocally excluded. Spheres assembled to the center of the station according to the requirements of the administrators did not ensure a landing under the assigned conditions. In the case of a small base the station (when the landing was on the slope of lunar formations, which no one could foresee) could turn out to be on the verge of toppling over.

What should be done?  
(the conclusion follows)